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Studies on *Cephalotrichum* from soils in China — twelve new species and two new combinations

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Abstract — A study of *Cephalotrichum* species diversity in soils of China resulted in twelve new species: *Cephalotrichum acutisporum*, *C. cylindrosporum*, *C. ellipsoideum*, *C. inflatum*, *C. longicollum*, *C. macrosporum*, *C. oblongum*, *C. ovoideum*, *C. robustum*, *C. spirale*, *C. terricola*, *C. verrucipes*. These species are illustrated and described in this paper. The type specimens (dried cultures) and living cultures are deposited in the Plant Pathology Herbarium of Shandong Agricultural University (HSAUP). Two *Doratomyces* species are transferred to *Cephalotrichum*.

Key words — anamorphic fungi, taxonomy

Introduction

The genus *Cephalotrichum* was established by Link (1809) with *C. stemonitis* as type species. This genus produces its spores in a dry head at the apex of a complex, erect conidiophore or synnema, which is often up to a millimeter in height. The synnemata produce chains of powdery conidia with a 'bottle brush' or 'feather' appearance. The ovoid conidia are produced from annellidic conidiogenous cells covering the sporogenous area (Chlebicki 2008). About 50 taxa of *Cephalotrichum* have been reported (http://www.indexfungorum.org/Names/Names.asp).

Doratomyces was proposed by Corda (1829), with *D. neesii* as type species. However, the probable synonymy of *Cephalotrichum* and *Doratomyces* has been a subject of debate for many years. Hughes (1958) and von Arx (1981) accepted *Doratomyces* as a synonym of *Cephalotrichum,* whereas Morton & Smith (1963),

Y.L. Jiang and J.J. Xu contributed equally to this work.

Domsch et al. (2007), and Kirk et al. (2008) accepted *Doratomyces* as a separate genus. In this paper, we treat *Doratomyces* as a synonym of *Cephalotrichum*.

During research on soil dematiaceous hyphomycetes in China, we obtained twelve fungi that possessed the typical *Cephalotrichum* characters but did not match other species in this genus. These fungi are described as new taxa and two *Doratomyces* species are transferred to *Cephalotrichum*, as new combinations.

Materials & methods

The methods of sample collection, isolation and identification of fungi, and preparation of dried cultures were as previously reported by Jiang & Zhang (2007). Conidia and conidiophores were placed in a drop of lactic acid, examined, and photographed using light microscopy. Mature conidia and conidiophores were measured by using a Nikon 90i microscope (Nikon Corporation, Japan) at 100× magnification. The fungi are described from cultures grown on potato dextrose agar (PDA; 20 g white potato boiled and filtered, 20 g dextrose, 20 g agar, 1 L distilled water).

Taxonomy

Cephalotrichum acutisporum J.J. Xu & T.Y. Zhang, **sp. nov.** Fig. 1

MycoBank MB 561106

Coloniae effusae, floccosae vel pulveraceae, fuscae vel atrae, in PDA crescentes lentissime et attingentes diametrum 2–4 centimetri ad 25°C post duas hebdomadas, reverse atro-brunneae vel fuscae. Mycelium plerumque superficiale, ex hyphis pallide brunneis vel brunneis, laevibus, septatis, ramosis, 1.5–3.5 µm crassis, in funiculos floccosos interdum assurgens. Synnemata 120–820 µm alta, stipitata, atro-brunnea vel fusca, capitulo cylindrica et ellipsoidea. Conidiophora pallide brunnea vel brunnea, ramosa, septata, laevia, 1–4 µm lata, basin 1.5–3.5 µm lata. Celluae conidiogenae percurrentes (annellophora), ampuliformes, penicilliformiter dispositae, 4–10 × 2–3 µm. Conidia catenata, ellipsoidea vel cylindrica, basin truncata et apicem acuta, dilute brunnea vel brunnea, laevia, 5–6 × 2.5–3 µm.

Holotype: China. Fujian Province, Zhangping, from soil of a park, 22 October 2004, J.J. Xu ($HSAUPII_{04}2724$, dried culture, **holotype**; HMAS196222, **isotype**).

Etymology: in reference to the conidia, which are pointed at the apex.

Colonies on PDA effuse, floccose or powdery, at first greenish grey, finally blackish brown to black with the formation of abundantly sporing structures and synnemata, reverse dark brown to blackish brown, growing slow, reaching 2–4 cm diameter at 25°C after two weeks. Mycelium mostly superficial, composed of pale to mid brown, smooth, septate, branched, 1.5–3.5 µm wide hyphae that occasionally aggregate forming ropes. Synnemata 120–820 µm high, stipes dark brown to blackish brown, with cylindrical or ellipsoidal heads. Conidiophores pale brown to brown, branched, septate, smooth, 1–4 µm wide, 1.5–3.5 µm wide at the base. Conidiogenous cells (annellophores) ampuliform, penicillately arranged, 4–10 × 2–3 µm. Conidia catenate, ellipsoidal to cylindrical, truncate at the base and pointed at the apex, pale to mid brown, smooth, 5–6 × 2.5–3 µm, L/W = 2.

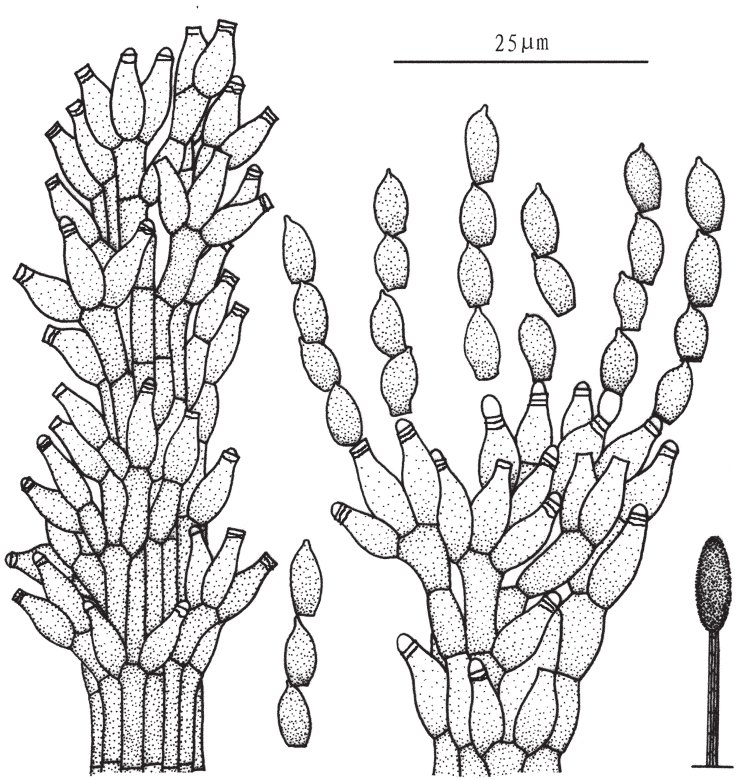

Fig. 1. *Cephalotrichum acutisporum*: conidia, conidiogenous cells and synnema.

Comments: *C. acutisporum* is most similar to *C. stemonitis* (Pers.) Link (Link 1809) and *C. microsporum* (Sacc.) P.M. Kirk (Kirk & Spooner 1984). However, conidia of *C. acutisporum* are ellipsoidal to cylindrical, but those of *C. microsporum* and *C. stemonitis* are ovoid. Conidia are larger (6–8.5 × 4–4.5 μm) in *C. stemonitis* and broader (3–4 μm) in *C. microsporum* than those of *C. acutisporum,* while synnemata are shorter (600 μm) in *C. microsporum* and longer (≤ 1200 μm) in *C. stemonitis* (Ellis 1971, Morton & Smith 1963).

Cephalotrichum cylindrosporum Y.L. Zhang & T.Y. Zhang, **sp. nov.** Fig. 2

MycoBank MB 561114

Coloniae effusae, pulveraceae, glaucae vel nigro-virentes, reverse brunneae, in PDA crescentes lentissime et attingentes diametrum 3–4 centimetri ad 25°C post duas hebdomadas. Mycelium plerumque superficiale, ex hyphis dilute brunneis vel brunneis, laevibus, septatis, ramosis, 2–2.5 μm crassis. Synnemata 750–900 μm alta, capitulo

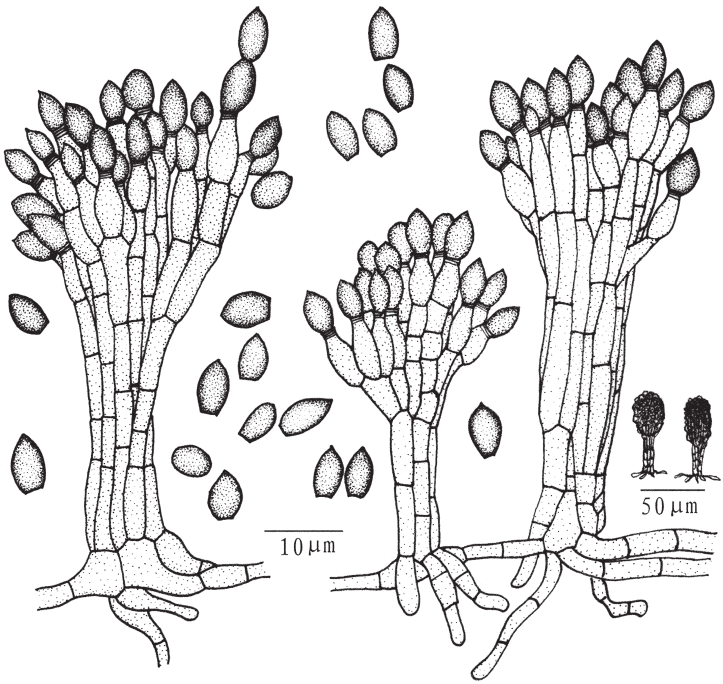

Fig. 2. *Cephalotrichum cylindrosporum*: conidia, conidiogenous cells and synnemata.

elongato-fusiformi stipitata, atro-brunnea, 15–20 μm lata. Celluae conidiogenae percurrentes (annellophora), ampuliformes, penicilliformiter dispositae, pallide brunneae vel brunneae, laeves, 9–11.5 × 2.5–3.5 μm. Conidia acrogena, solitaria vel catenata, cylindrica vel subcylindrica, in extremitatibus rotundata, brunnea, laevia, 5.0–6.2 × 2.5–3.2 μm.

Holotype: China. Hainan Province, Tunchang, from a rice field soil, 1 November 2005, Y.L. Zhang (HSAUPII$_{05}$2414, dried culture, **holotype**; HMAS196223, **isotype**).

Etymology: in reference to cylindrical conidia.

Colonies on PDA effuse, powdery, glaucous to greenish black with the formation of abundantly sporulating structures and synnemata, reverse brown, growing slow, reaching 3–4 cm diameter at 25°C after two weeks. Mycelium mostly superficial, composed of pale brown to brown, smooth, septate, branched, 2–2.5 μm wide hyphae. Synnemata 750–900 μm high, with long fusiform heads, stipes dark brown, 15–20 μm wide. Conidiogenous cells (annellophores) ampuliform, penicillately arranged, pale brown to brown, smooth, 9–11.5 × 2.5–3.5 μm. Conidia acrogenous, simple or occasionally catenate, cylindrical or subcylindrical, rounded at the ends, brown, smooth, 5.0–6.2 × 2.5–3.2 μm.

Comments: *Cephalotrichum cylindrosporum* is similar to *C. cuneiferum* in the shape of conidia, but in *C. cuneiferum* the conidia are longer (6–13 × 2.5–4 μm), synnemata are generally wider (10–40 μm), and the conidiogenous cells are longer (10–35 μm) (Matsushima 1975).

Cephalotrichum ellipsoideum H.Q. Pan & T.Y. Zhang, **sp. nov.** Fig. 3

MycoBank MB 561108

Coloniae effusae, pulveraceae, griseo-brunnea, reverse brunnea, in PDA crescentes lentissime et attingentes diametrum 2.5–4 centimetri ad 25°C post duas hebdomadas. Mycelium plerumque superficiale, ex hyphis dilute brunneis vel brunneis, laevibus, septatis, ramosis, 1.5–2.5 μm crassis, in funiculos floccosos saepe assurgens. Synnemata 100–500 μm alta, capitulo ellipsoidea et ovoidea, stipitata, atro-brunnea, 6–14 μm lata. Conidiophora brunnea, septata, ramosa. Celluae conidiogenae percurrentes (annellophora), ampuliformes, penicilliformiter dispositae, 7.5–12.5 μm longae, basi tumidulae 3–4 μm diam, quae in zonam annellatam, 1.5–3 μm diam, dilute brunneae, laeves. Conidia catenata, late ellipsoidea vel obovoidea, basin truncata et apicem rotundata, brunnea, laevia, 6–8.5 × 3.5–6 μm.

Holotype: China. Qinghai Province, Maduo, from a grassland soil, 8 June 2007, H.Q. Pan (HSAUPII$_{07}$4053, dried culture, **holotype**; HMAS196224, **isotype**).

Etymology: in reference to the ellipsoidal conidia.

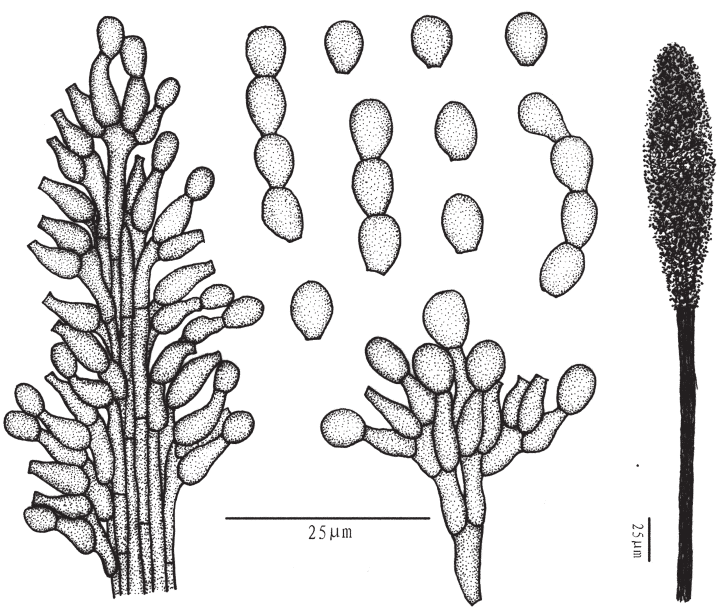

Fig. 3. *Cephalotrichum ellipsoideum*: conidia, conidiogenous cells and synnema.

Colonies on PDA effuse, powdery, greyish brown, reverse brown, growing slow, reaching 2.5–4 cm diameter at 25°C after two weeks. Mycelium mostly superficial, composed of pale brown to brown, smooth, septate, branched, 1.5–2.5 µm wide hyphae which usually aggregate forming ropes. Synnemata 100–500 µm high, with ellipsoidal to ovoid heads, stipes dark brown, 6–14 µm wide. Conidiophores brown, septate, branched. Conidiogenous cells (annellophores) ampuliform, penicillately arranged, 7.5–12.5 µm long, swollen base 3–4 µm diam, tapering abruptly into the annellated zone 1.5–3 µm diam, pale brown, smooth. Conidia catenate, broadly ellipsoidal to obovoid, truncate at the base and rounded at the apex, brown, smooth, 6–8.5 × 3.5–6 µm.

Comments: The conidia of *C. ellipsoideum* resemble those of *C. purpureofuscum* (Schwein.) S. Hughes (Hughes 1958), which, however, are slightly smaller (5–7 × 3.5–4.5 µm). In *C. purpureofuscum* the synnemata are also differently shaped (globose or subglobose) and taller (≤ 900 µm) (Ellis 1971).

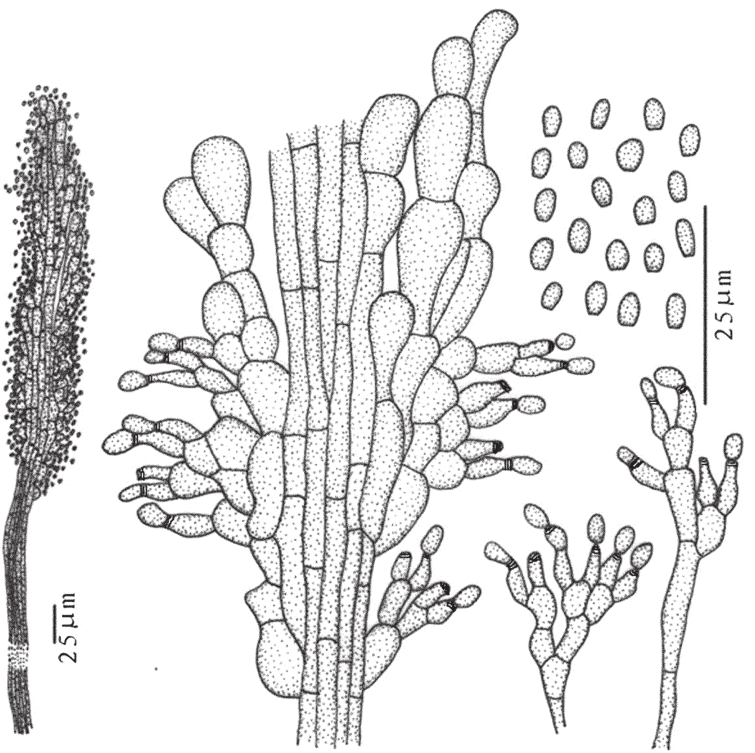

Fig. 4. *Cephalotrichum inflatum*: conidia, conidiogenous cells and synnema.

Cephalotrichum inflatum Y.L. Jiang & T.Y. Zhang, **sp. nov.** Fig. 4

MycoBank MB 561110

Coloniae effusae, floccosae, griseo-brunneae, reverse brunneae. Mycelium partem superficiale et partem immersum, ex hyphis hyalinis, ramosis, septatis, laevibus, 1.5–5.5 µm crassis. Synnemata 160–700 µm alta, capitulo fusiformia et subcylindrica, stipitata, atro-brunnea, 9–30 µm lata. Conidiophora inflata. Celluae conidiogenae percurrentes (annellophora), ampuliformes, penicilliformiter dispositae, 3–6.5 µm longae, basi tumidulae 2–3 µm diam, quae in zonam annellatam, 1–2 µm diam. Conidia solitaria vel catenata, late obovoidea vel subellipsoidea, basin truncata, apicem rotundata vel leviter acuta, laevia, pallide brunnea vel brunnea, 3–4.5 × 2–2.5 µm.

Holotype: China. Sichuan Province, Mianyang, from a mountain soil, 8 August 2005, Y.L. Jiang (HSAUPII$_{05}$0918, dried culture, **holotype**; HMAS196226, **isotype**).

Etymology: in reference to the inflated conidiophores.

Colonies on PDA effuse, at first powdery, finally floccose, greyish brown, reverse brown. Mycelium partly superficial, partly immersed, composed of hyaline, branched, septate, smooth, 1.5–5.5 µm wide hyphae. Synnemata 160–700 µm high, with fusiform or subcylindrical heads, stipes dark brown, 9–30 µm wide. Conidiophores often inflated. Conidiogenous cells (annellophores) ampuliform, penicillately arranged, 3–6.5 µm long, swollen base 2–3 µm diam, tapering abruptly into the annellated zone 1–2 µm diam. Conidia solitary or occasionally catenate, broadly obovoid to subellipsoidal, truncate at the base, rounded or slightly pointed at the apex, smooth, pale to mid brown, 3–4.5 × 2–2.5 µm.

Comments: *Cephalotrichum inflatum* differs from all previously described *Cephalotrichum* species by its distinctly inflated conidiophores.

Cephalotrichum longicollum Y.L. Jiang & T.Y. Zhang, **sp. nov.** Fig. 5

MycoBank MB 561111

Coloniae effusae, floccosae, fuscae, reverse brunneo-virens. Mycelium partem superficiale et partem immersum, ex hyphis hyalinis, ramosis, septatis, laevibus, 1–3 µm crassis. Synnemata 340–750 µm alta, capitulo elongato-cylindrica, stipitata, atro-brunnea, 6–25 µm lata. Celluae conidiogenae percurrentes (annellophora) ampuliformes, longicollo, penicilliformiter dispositae, 9–15.5 µm longae, basi tumidulae 3–6 µm diam, quae in zonam annellatam, 1–2.5 µm diam. Conidia solitaria vel catenata, ellipsoidea vel late ellipsoidea, brunnea, basin truncata, apicem rotundata vel interdum leviter acuta, laevia, 4.5–5.5 × 2.5–4 µm.

Holotype: China. Sichuan Province, from a soil of Emei Mountain, 9 August 2005, Y.L. Jiang (HSAUPII$_{05}$0802, dried culture, **holotype**; HMAS196228, **isotype**).

Etymology: in reference to the annellophores with long necks.

Colonies on PDA effuse, at first powdery, finally floccose, blackish brown, reverse greenish brown. Mycelium partly superficial, partly immersed, composed of hyaline, branched, septate, smooth, 1–3 µm wide hyphae. Synnemata 340–750 µm high, with long cylindrical heads, stipes dark brown, 6–25 µm wide.

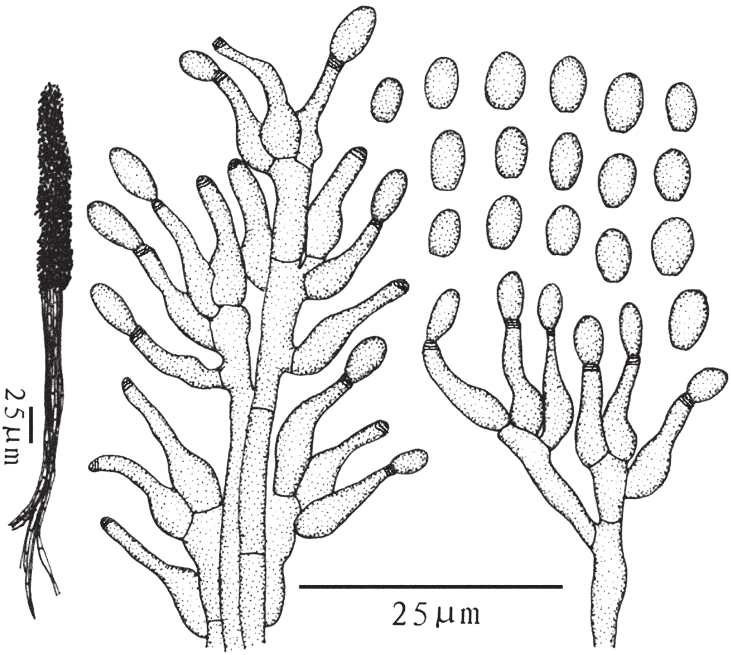

Fig. 5. *Cephalotrichum longicollum*: conidia, conidiogenous cells and synnema.

Conidiogenous cells (annellophores) ampuliform with long neck, penicillately arranged, 9–15.5 μm long, swollen base 3–6 μm diam, tapering abruptly into the annellated zone 1–2.5 μm diam. Conidia solitary or catenate, ellipsoidal to broadly ellipsoidal, smooth, mid brown, truncate at the base, rounded or sometimes slightly pointed at the apex, 4.5–5.5 × 2.5–4 μm.

Comments: *Cephalotrichum longicollum* is distinguished from all previously described *Cephalotrichum* species by annellophores with long neck and wider (3–6 μm) swollen base. Only *C. cuneiferum* (Berk. & Broome) Kuntze (Kuntze 1898) produces annellophores with a longer neck. However, shape of the conidia distinguishes these two species (Matsushima 1975).

Cephalotrichum macrosporum Y.L. Jiang & T.Y. Zhang, **sp. nov.** Fig. 6

MycoBank MB 561112

Coloniae effusae, floccosae, griseo-brunneae, reverse fuscae. Mycelium partem superficiale et partem immersum, ex hyphis hyalinis, ramosis, septatis, laevibus, 1–3 μm crassis. Synnemata 200–600 μm alta, capitulo cylindrica vel elongato-cylindrica, stipitata, atro-brunnea, 10–22 μm lata. Celluae conidiogenae percurrentes (annellophora), ampuliformes, penicilliformiter dispositae, 6.5–13 μm longae, basi tumidulae 2.5–3.5 μm diam, quae in zonam annellatam, 1–2.5 μm diam. Conidia solitaria vel catenata, cylindrica vel ovoidea,

longa ellipsoidea, brunnea, laevia, basin truncata, apicem rotundata, 5.5–12 × 2.5–4.5 µm.

Holotype: China. Sichuan Province, from a forest soil of Jiuzhaigou, 18 August 2005, Y.L. Jiang (HSAUPII$_{05}$0878, dried culture, **holotype**; HMAS196229, **isotype**).

Etymology: in reference to the large conidia.

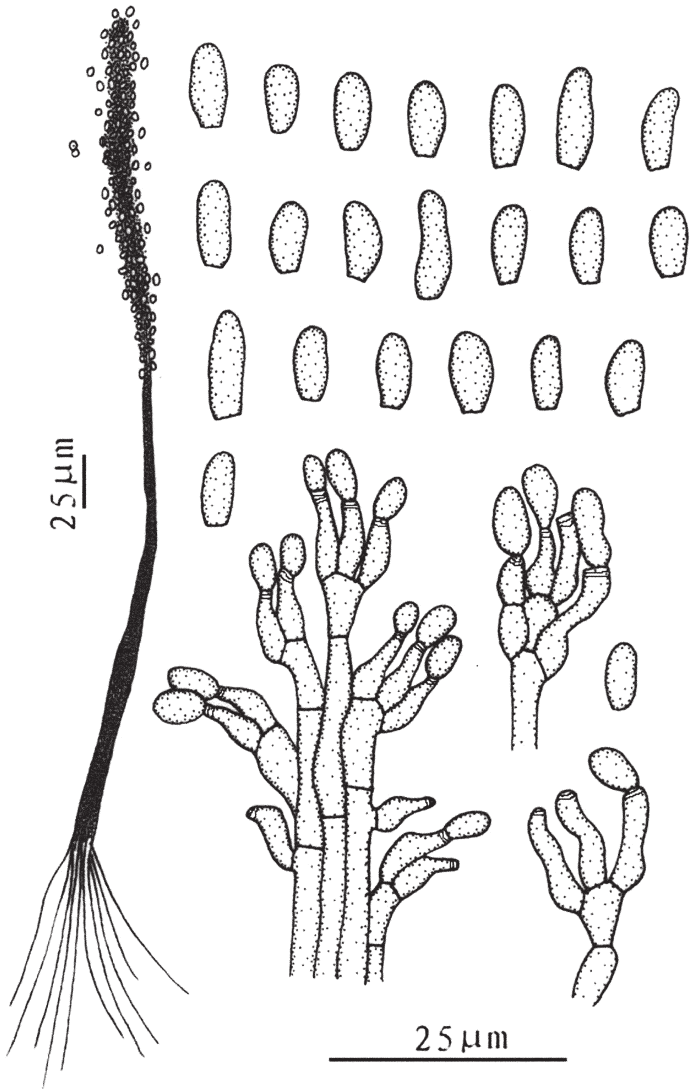

Fig. 6. *Cephalotrichum macrosporum*: conidia, conidiogenous cells and synnema.

Colonies on PDA effuse, at first powdery, finally floccose, greyish brown, reverse blackish brown. Mycelium partly superficial, partly immersed, composed of hyaline, branched, septate, smooth, 1–3 µm wide hyphae. Synnemata 200–600 µm high, with cylindrical to long cylindrical heads, stipes dark brown, 10–22 µm wide. Conidiogenous cells (annellophores) ampuliform, penicillately arranged, 6.5–13 µm long, swollen base 2.5–3.5 µm diam, tapering abruptly into the annellated zone 1–2.5 µm diam. Conidia solitary or catenate, cylindrical to ovoid or long ellipsoidal, mid brown, smooth, truncate at the base and rounded at the apex, 5.5–12 × 2.5–4.5 µm.

Comments: *Cephalotrichum cuneiferum* also produces cylindrical conidia but they are slightly larger than those of *C. macrosporum*. In addition, both the annellophores and synnemata of *C. macrosporum* are shorter than *C. cuneiferum* (Matsushima 1975).

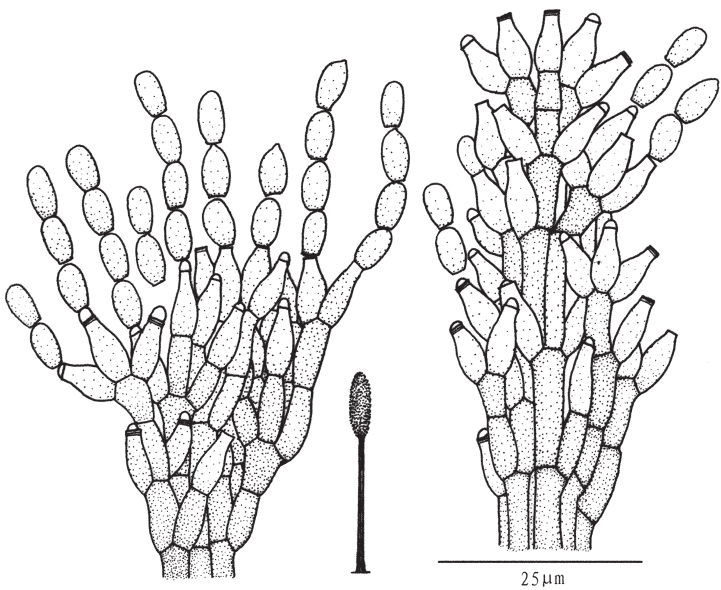

Fig. 7. *Cephalotrichum oblongum*: conidia, conidiogenous cells and synnemata.

Cephalotrichum oblongum J.J. Xu & T.Y. Zhang, **sp. nov.** Fig. 7

MycoBank MB 561113

Coloniae effusae, pulveraceae vel velutinae, griseae, brunneo-virens vel fuscae, reverse fuscae, in PDA crescentes mediocris et attingentes diametrum 6.5 centimetri ad 25°C post duas hebdomadas. Mycelium plerumque superficiale, ex hyphis dilute brunneis vel brunneis, ramosis, septatis, laevibus, 2–2.5 µm crassis, in funiculos floccosos interdum assurgens. Synnemata 90–200 µm alta, capitulo ellipsoidea, 10–21 µm lata. Conidiophora dilute brunnea vel atro-brunnea, laevia, septata, 2–3 µm lata. Celluae conidiogenae

percurrentes (annellophora), ampuliformes, penicilliformiter dispositae, 6–10 × 2–3 µm. Conidia catenata, breve cylindrica vel oblonga, basi truncata, apicem rotundata, brunnea, laevia, 3.5–7.5 × 2–2.5 µm.

Holotype: China. Yunnan Province, from a soil of Pingbian County, 11 October 2004, J.J. Xu (HSAUPII$_{04}$2723, dried culture, **holotype**; HMAS196230, **isotype**).

Etymology: in reference to the oblong conidia.

Colonies on PDA effuse, powdery or velvety, grey, greenish brown to blackish brown with the formation of abundantly sporulating structures and synnemata, reverse blackish brown, growing moderately fast, reaching 6.5 cm diameter at 25°C after two weeks. Mycelium mostly superficial, composed of pale brown to brown, branched, septate, smooth, 2–2.5 µm wide hyphae which may occasionally aggregate forming ropes. Synnemata 90–200 µm high, with ellipsoidal heads, 10–21 µm wide. Conidiophores pale to dark brown, smooth, septate, 2–3 µm wide. Conidiogenous cells (annellophores) ampuliform, penicillately arranged, 6–10 × 2–3 µm. Conidia catenate, short cylindrical or oblong, truncate at the base and rounded at the apex, brown, smooth, 3.5–7.5 × 2–2.5 µm.

Comments: Both *C. purpureofuscum* and *C. microsporum* also produce oblong conidia, which, however, differ in size. In *C. oblongum* annellophores are narrower than those of *C. purpureofuscum* and synnemata are shorter than those of *C. purpureofuscum* and *C. microsporum* (Morton & Smith 1963).

Cephalotrichum ovoideum Y.L. Jiang & T.Y. Zhang, **sp. nov.** Fig. 8

MycoBank MB 561115

Coloniae effusae, floccosae, fuscae, reverse flavo-brunneae. Mycelium partem superficiale et partem immersum, ex hyphis hyalinis, ramosis, septatis, laevibus, 1–2.5 µm crassis. Synnemata 250–800 µm alta, ramaso, capitulo sphaerica vel subsphaerica, stipitata, atro-brunnea, 9–25 µm lata. Celluae conidiogenae percurrentes (annellophora), ampuliformes vel obclavatae, penicilliformiter dispositae, 6–13 µm longae, basi tumidulae 2.5–3.7 µm diam, quae in zonam annellatam, 1.5–2 µm diam. Conidia solitaria vel catenata, dilute flavo-brunnea vel flavo-brunnea, ovoidea, obpyriformia vel subsphaerica, apicem acuta vel interdum rotundata, basin truncata, laevia, 4.5–7 × 3–4 µm.

Holotype: China. Sichuan Province, Jiuzhaigou, from a forest soil, 18 August 2005, Y.L. Jiang (HSAUPII$_{05}$0846, dried culture, **holotype**; HMAS196231, **isotype**).

Etymology: in reference to the ovoid conidia.

Colonies on PDA effuse, at first powdery, finally floccose, blackish brown, reverse yellowish brown. Mycelium partly superficial, partly immersed, composed of hyaline, branched, septate, smooth, 1–2.5 µm wide hyphae. Synnemata 250–800 µm high, branched with spherical or subspherical heads, stipes dark brown, 9–25 µm wide. Conidiogenous cells (annellophores) ampuliform to obclavate, penicillately arranged, 6–13 µm long, swollen base 2.5–3.7 µm diam, tapering abruptly into the annellated zone 1.5–2 µm diam. Conidia solitary

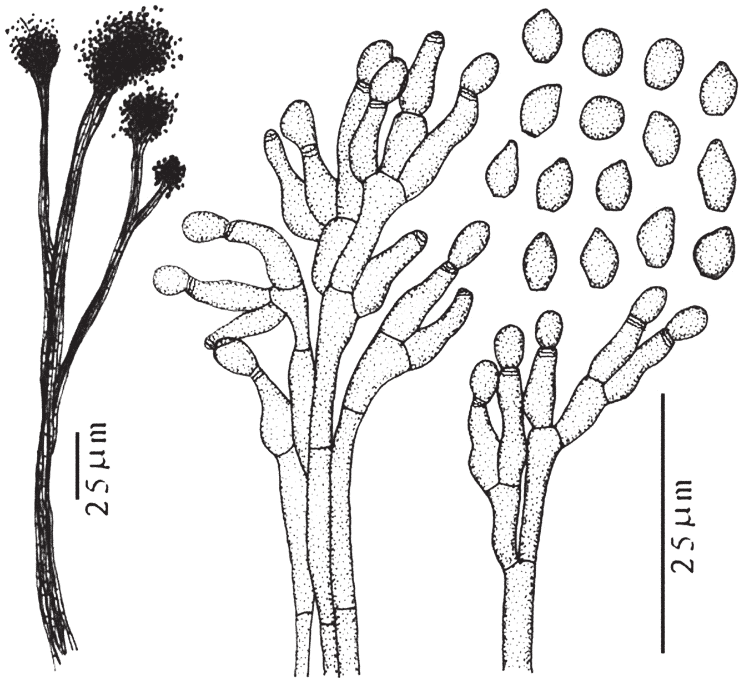

Fig. 8. *Cephalotrichum ovoideum*: conidia, conidiogenous cells and synnemata.

or catenate, pale yellowish brown to yellowish brown, ovoid, obpyriform or subspherical, usually pointed at the apex or sometimes rounded, truncate at the base, smooth, 4.5–7 × 3–4 µm.

Comments: *Cephalotrichum ovoideum* resembles *C. purpureofuscum* and *C. byssoides* in conidial morphology, but the conidia of *C. purpureofuscum* are usually rounded at the apex and its synnemata are unbranched. Conidial ornamentation and size clearly distinguish *C. ovoideum* and *C. byssoides* (Morton & Smith 1963, Mason & Ellis 1953).

Cephalotrichum robustum Y.L. Jiang & T.Y. Zhang, **sp. nov.** Fig. 9

MycoBank MB 561116

Coloniae effusae, floccosae, brunneo-virens, reverse flavo-brunnea. Mycelium partem superficiale et partem immersum, ex hyphis hyalinis, ramosis, septatis, laevibus, 1–3 µm crassis. Synnemata 250–750 µm alta, capitulo cylindrica et elongato-ellipsoidea, stipitata, atro-brunnea, 6–25 µm lata. Celluae conidiogenae percurrentes (annellophora), subcylindricae, robustae, penicilliformiter dispositae, 4–8 µm longae, basi tumidulae 2–4 µm diam, zonam annellatam 1.5–2.5 µm diam. Conidia solitaria vel catenata, late ellipsoidea vel subsphaerica, basin truncata, apicem rotundata, flavo-brunnea, laevia, 5–7 × 3–5 µm.

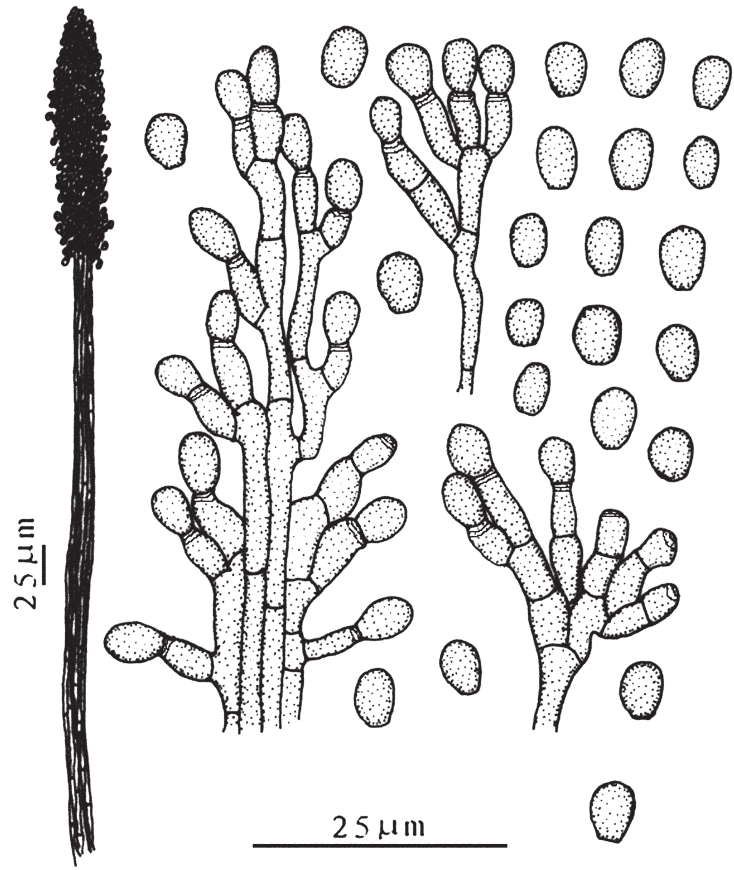

Fig. 9. *Cephalotrichum robustum*: conidia, conidiogenous cells and synnema.

Holotype: China. Sichuan Province, from a forest soil of Jiuzhaigou, 18 August 2005, Y.L. Jiang (HSAUPII$_{05}$0875, dried culture, **holotype**; HMAS196232, **isotype**).

Etymology: in reference to the thickset annellophores.

Colonies on PDA effuse, at first powdery, finally floccose, greenish brown, reverse yellowish brown. Mycelium partly superficial, partly immersed, composed of hyaline, branched, septate, smooth, 1–3 μm wide hyphae. Synnemata 250–750 μm high, with cylindrical to long ellipsoidal heads, stipes dark brown, 6–25 μm wide. Conidiogenous cells (annellophores) subcylindrical, thickset, penicillately arranged, 4–8 μm long, swollen base 2–4 μm diam, the annellated zone 1.5–2.5 μm diam. Conidia solitary or catenate, broadly ellipsoidal to subspherical, truncate at the base and rounded at the apex, yellowish brown, smooth, 5–7 × 3–5 μm.

Comments: *Cephalotrichum robustum* morphologically resembles *C. ellipsoideum*, *C. longicollum*, *C. castaneum* (Jiang & Zhang 2008), and *C. purpureofuscum*. The annellophores of *C. robustum* are the shortest among these five species. In addition, synnemata of *C. robustum* are shorter than in *C. purpureofuscum* and *C. castaneum*, longer than in *C. ellipsoideum* (Ellis 1971), and about the same length as in *C. longicollum*. However, the conidia of *C. robustum* are bigger than those of *C. longicollum*.

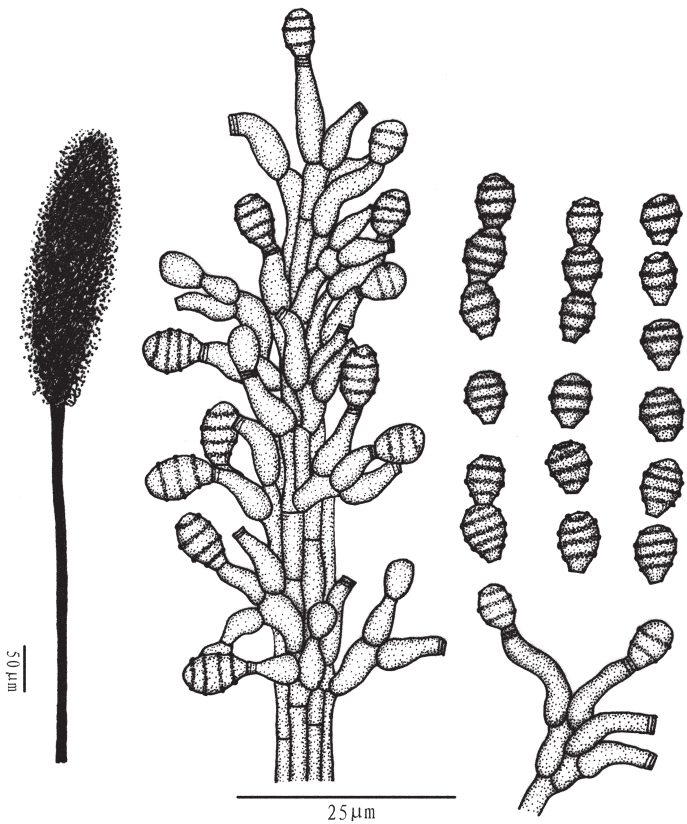

Fig. 10. *Cephalotrichum spirale*: conidia, conidiogenous cells and synnema.

Cephalotrichum spirale H.M. Liu, H.Q. Pan & T.Y. Zhang, **sp. nov.** Fig. 10

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Coloniae effusae, floccosae, atrogriseae vel atrae, in PDA crescentes lentissime et attingentes diametrum 4 centimetri ad 25°C post duas hebdomadas. Mycelium plerumque superficiale, ex hyphis hyalinis, ramosis, septatis, laevibus, 1–2.5 µm crassis. Synnemata 700 µm alta, capitulo ellipsoidea et cylindrica, stipitata, atro-brunnea, 10–15 µm lata. Celluae

conidiogenae percurrentes (annellophora), ampuliformes vel obclavatae, penicilliformiter dispositae, 6–12 µm longae, basi tumidulae 2–3.5 µm diam, quae in zonam annellatam, 1–2 µm diam. Conidia solitaria vel catenata, brunnea, late obovoidea vel late ellipsoidea, basin truncata et apicem rotundata, spiraliter disposita verruculosa, 5–7 × 3–4.5 µm, in universum fusca.

Holotype: China. Qinghai Province, from a grassland soil of Dari County, 12 June 2007, H.Q. Pan (HSAUPII$_{07}$4033, dried culture, **holotype**; HMAS196233, **isotype**).

Etymology: in reference to the verruculose conidia with verrucae in a spiral.

Colonies on PDA effuse, floccose, central sporulating area at first pale grey, the grey colour spreading and darkening to blackish, finally dark grey to black with the formation of abundantly sporulating structures and synnemata, growing slow, reaching 4 cm diameter at 25°C after two weeks. Mycelium mostly superficial, composed of hyaline, branched, septate, smooth, 1–2.5 µm wide hyphae. Synnemata 700 µm high, with ellipsoidal to cylindrical heads, stipes dark brown, 10–15 µm wide. Conidiogenous cells (annellophores) ampuliform to obclavate, penicillately arranged, 6–12 µm long, swollen base 2–3.5 µm diam, tapering abruptly into the annellated zone 1–2 µm diam. Conidia solitary or catenate, brown, broadly obovoid to broadly ellipsoidal, truncate at the base and rounded at the apex, verruculose, verrucae arranged in a spiral, 5–7 × 3–4.5 µm, blackish brown in mass.

Comments: Based on the presence of ornamented conidia, *C. spirale* is similar to *C. stemonitis*, *C. byssoides*, *C. phillipsii*, *C. nanum* (Ehrenb.) S. Hughes (Hughes 1958), and *C. verrucisporum* (Jiang & Zhang 2008). However, conidial shape distinguishes *C. spirale* from the other five species. In addition, synnemata of *C. spirale* are longer than in *C. phillipsii* and shorter than in *C. stemonitis*, *C. nanum*, *C. byssoides,* and *C. verrucisporum* (Mason & Ellis 1953, Morton & Smith 1963, Jiang & Zhang 2008).

Cephalotrichum terricola Y.L. Jiang & T.Y. Zhang, **sp. nov.** Fig. 11

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Coloniae effusae, floccosae, brunneo-virens, reverse fuscae. Mycelium partem superficiale et partem immersum, ex hyphis hyalinis, ramosis, septatis, laevibus, 1–3 µm crassis. Synnemata 300–660 µm alta, capitulo fusiformia vel elongato-cylindrica, stipitata, atro-brunnea, 9–19 µm lata. Celluae conidiogenae percurrentes (annellophora), ampuliformae, penicilliformiter dispositae, 4.5–9.5 µm longae, basi tumidulae 2–4.5 µm diam, quae in zonam annellatam, 1–2 µm diam. Conidia solitaria vel catenata, obovoidea vel ellipsoidea, flavo-brunnea, laevia, basin truncata, apicem rotundata vel interdum leviter acuta, 4.5–7×2.5–3.5 µm.

Holotype: China. Sichuan Province, Panzhihua, from a mountain soil, China. 13 August 2005, Y.L. Jiang (HSAUPII$_{05}$0924, dried culture, **holotype**; HMAS196227, **isotype**).

Etymology: in reference to the habitat.

Colonies on PDA effuse, at first powdery, finally floccose, greenish brown, reverse blackish brown. Mycelium partly superficial, partly immersed,

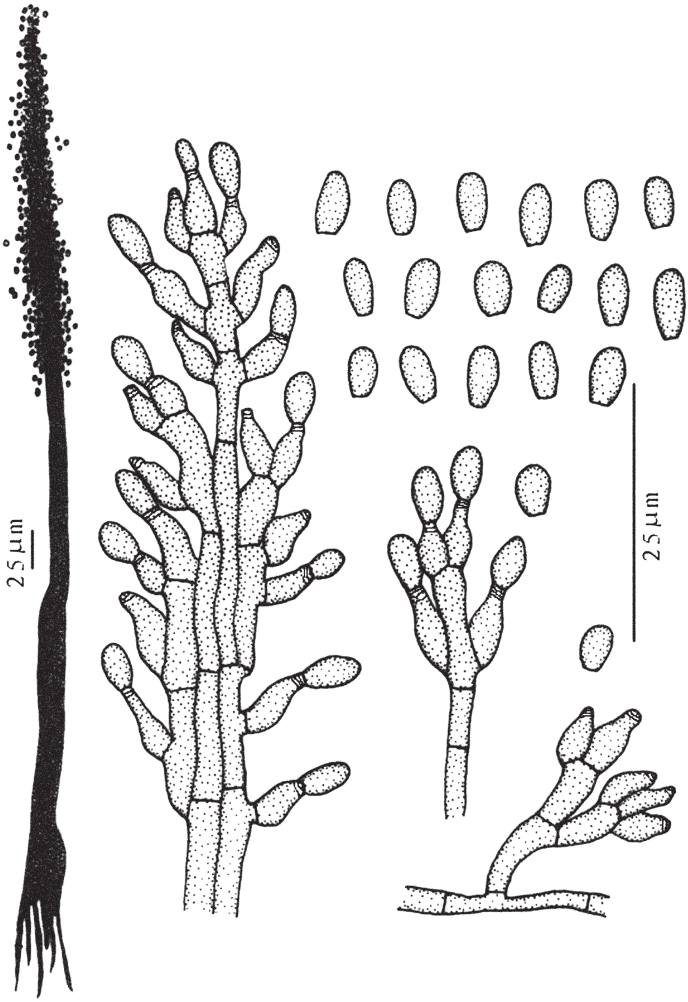

Fig. 11. *Cephalotrichum terricola*: conidia, conidiogenous cells and synnema.

composed of hyaline, branched, septate, smooth, 1–3 µm wide hyphae. Synnemata 300–660 µm high, with fusiform to long cylindrical heads, stipes dark brown, 9–19 µm wide. Conidiogenous cells (annellophores) ampuliform, penicillately arranged, 4.5–9.5 µm long, swollen base 2–4.5 µm diam, tapering abruptly into the annellated zone 1–2 µm diam. Conidia solitary or catenate, obovoid to ellipsoidal, yellowish brown, smooth, truncate at the base, rounded or sometimes slightly pointed at the apex, 4.5–7 × 2.5–3.5 µm.

Comments: The species most similar to *C. terricola* in conidial morphology are *C. ellipsoideum* and *C. purpureofuscum,* except that those species produce wider conidia. Additionally, synnemata of *C. purpureofuscum* are longer (≤ 900 μm) with spherical or subspherical heads and those of *C. ellipsoideum* shorter (100–500 μm) with ellipsoidal to ovoid heads.

Cephalotrichum verrucipes Y.L. Jiang & T.Y. Zhang, **sp. nov.** Fig. 12

MycoBank MB 561119

Coloniae effusae, floccosae, brunneo-virens, reverse fuscae. Mycelium partem superficiale et partem immersum, ex hyphis hyalinis, ramosis, septatis, laevibus, 2–4.5 μm crassis. Synnemata 2800 μm alta, capitulo cylindrica vel ellipsoidea, stipitata, dilute brunnea, verruculosa, 25–66 μm lata. Conidiophora verruculosa. Celluae conidiogenae percurrentes (annellophora), longa ampuliformae vel obclavata, penicilliformiter disposita, 7–14 μm longa, basi leviter tumidula 1–2.5 μm diam, quae in zonam annellatam, 1–2 μm diam. Conidia solitaria vel catenata, sphaerica, subsphaerica vel ellipsoidea, laevia, dilute flavo-brunnea vel flavo-brunnea, 2–3.5 × 2–3 μm, in universum atro-brunnea.

Holotype: China. Sichuan Province, from a forest soil of Jiuzhaigou, 19 August 2005, Y.L. Jiang (HSAUPII$_{05}$0849, dried culture, **holotype**; HMAS196234, **isotype**).

Etymology: in reference to the verruculose conidiophores.

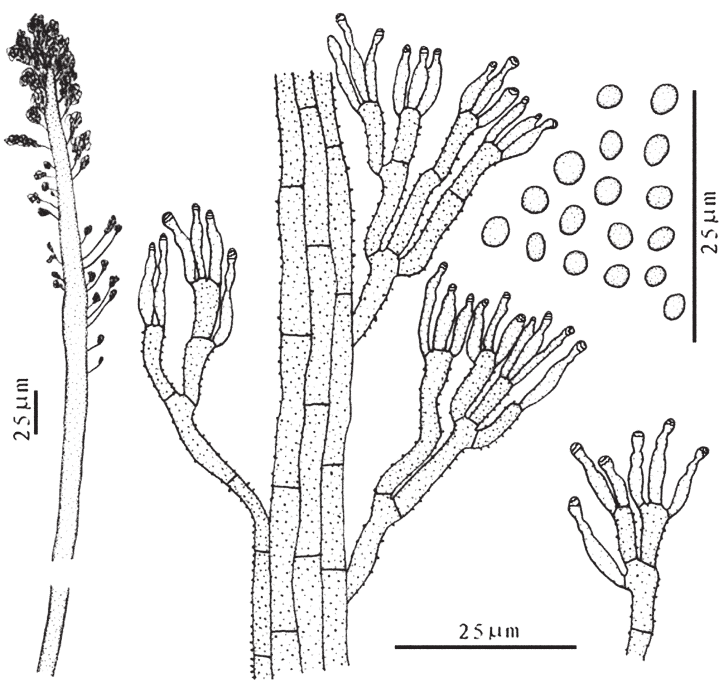

Fig. 12. *Cephalotrichum verrucipes*: conidia, conidiogenous cells and synnema.

Colonies on PDA effuse, at first powdery, finally floccose, greenish brown, reverse blackish brown. Mycelium partly superficial, partly immersed, composed of hyaline, branched, septate, smooth, 2–4.5 µm wide hyphae. Synnemata 2800 µm high, with cylindrical vel ellipsoidal heads, stipes pale brown, verruculose, 25–66 µm wide, stipes distinct, but density of branches of stipes nonuniform, disperse branches often in the middle part or below the stipes. Conidiophores verruculose. Conidiogenous cells (annellophores) long ampuliform to obclavate, penicillately arranged, 7–14 µm long, slightly swollen base 1–2.5 µm diam, tapering abruptly into the annellated zone 1–2 µm diam. Conidia solitary or catenate, spherical, subspherical to ellipsoidal, smooth, pale yellowish brown to yellowish brown, 2–3.5 × 2–3 µm, dark brown in mass.

Comments: *Cephalotrichum verrucipes* is the only species in the genus with verruculose conidiophores.

New combinations

The following two species, previously placed in *Doratomyces,* both produce spores in a dry head at the apex of a complex, erect condiophore synnema. For that reason we transfer them to *Cephalotrichum.*

Cephalotrichum castaneum (Y.L. Jiang & T.Y. Zhang) Y.L. Jiang & T.Y. Zhang, **comb. nov.**

MycoBank MB 561107

≡ *Doratomyces castaneus* Y.L. Jiang & T.Y. Zhang, Mycotaxon 104: 131, 2008.

Cephalotrichum verrucisporum (Y.L. Jiang & T.Y. Zhang) Y.L. Jiang & T.Y. Zhang, **comb. nov.**

MycoBank MB 561120

≡ *Doratomyces verrucisporus* Y.L. Jiang & T.Y. Zhang, Mycotaxon 104: 133, 2008.

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